

## Gradiometer Based on Nonlinear Magneto-Optic Rotation, Phase I

Completed Technology Project (2005 - 2005)



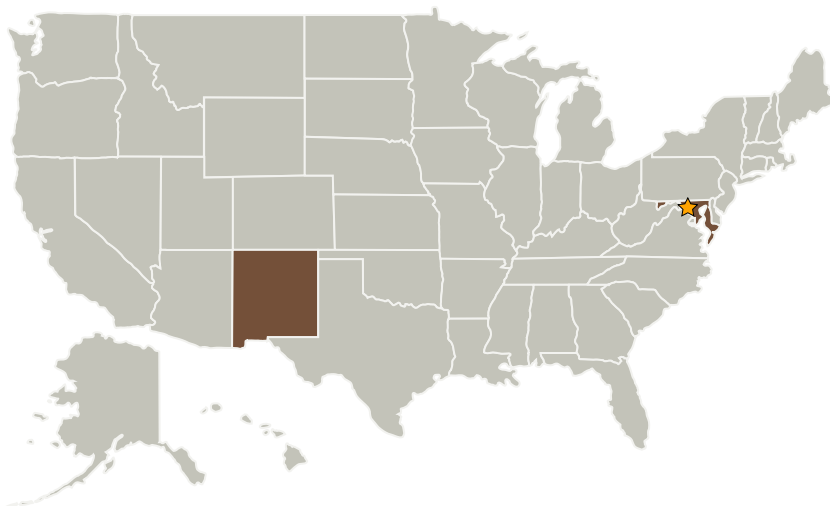
## Project Introduction

This Phase I SBIR project will demonstrate sensitive measurements of magnetic field gradients by nonlinear atomic spectroscopy. The gradients are determined by measuring the magnitudes of the magnetic fields in two atomic vapor cells. A vertical cavity surface emitting laser is used to create an atomic coherence. This coherent state is long lived because of the special construction of the atomic vapor cell. A measurement of the Larmor precession frequency of the coherent state gives a precise measurement of the magnetic field. The field measurement precision should be 0.3 fT in a 1 Hz bandwidth. Two such probes can be tethered at the ends of 80 m cables from a rotating space craft. Typical geophysical gradients of  $\sim 250$  fT can be measured from a single spacecraft with excellent signal/noise. The system uses no cryogenic fluids, no consumable chemicals, and will operate from a few Watts of electrical power.

## Anticipated Benefits

Precision magnetometry is used in oil and mineral exploration and hidden object detection at land and at sea. Applications include archeology and marine search and recovery. The extraordinary sensitivity of this approach opens up applications in advanced magnetic resonance imaging. Defense and homeland security applications include the detection of underwater or underground threats including submarines, camouflaged tanks, and mines. NASA applications include measurements of fields and field gradients in the magnetosphere from space, measurements of lunar and planetary fields, and more sensitive measurements of magnetic storms from Earth's surface.

## Primary U.S. Work Locations and Key Partners



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## Table of Contents

Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	1
Organizational Responsibility	1
Project Management	2
Technology Areas	2

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Goddard Space Flight Center (GSFC)

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
Southwest Sciences, Inc.	Supporting Organization	Industry	Santa Fe, New Mexico

## Primary U.S. Work Locations

Maryland	New Mexico
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## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Project Manager:**

Fred Herrero

**Principal Investigator:**

David Christian Hovde

## Technology Areas

**Primary:**

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - └ TX12.2 Structures
    - └ TX12.2.1 Lightweight Concepts